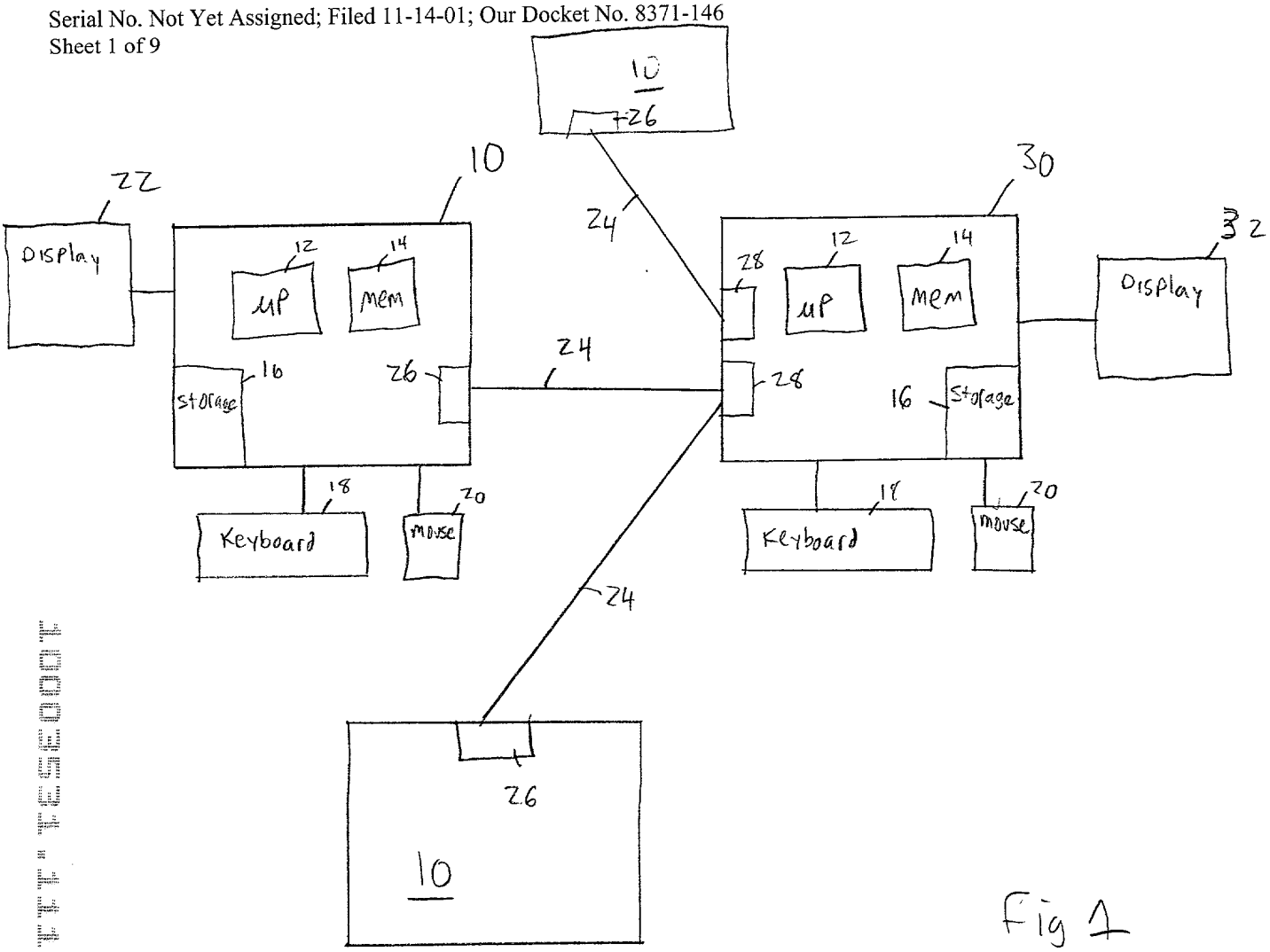

10
26
22
10
30
24
Display
12
14
32
28
12
14
Display
uP
mem
uP
mem
24
16
storage
26
28
16
Storage
18
20
18
20
Keyboard
mouse
Keyboard
mouse
24
26
10

Fig 1

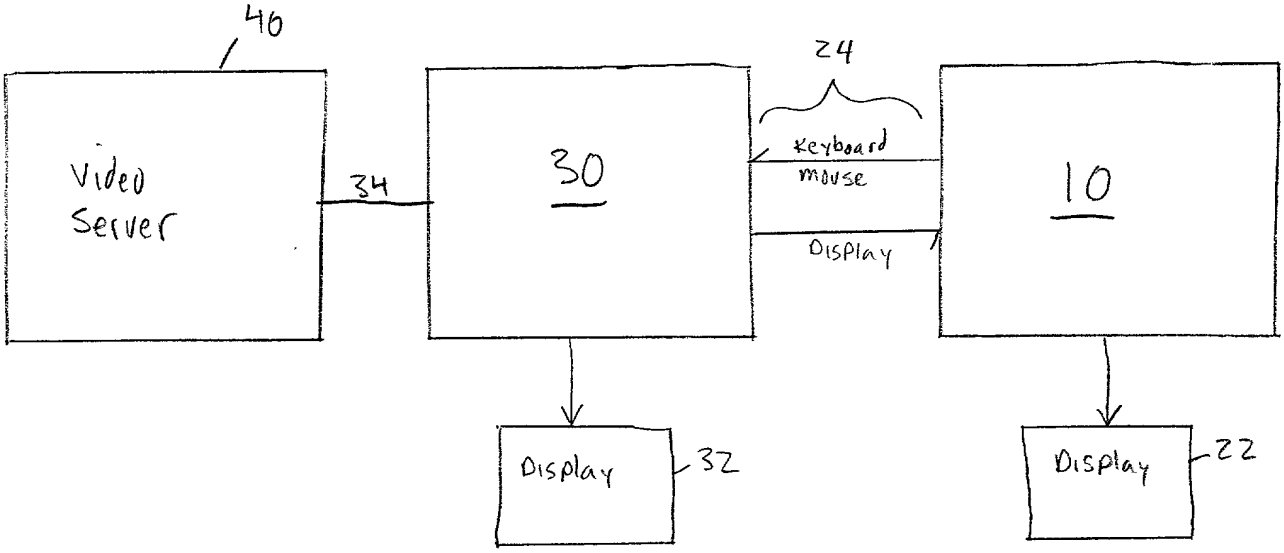

40
24
Video
Server
34
30
Keyboard
mouse
10
Display
Display
32
Display
22

Fig 2

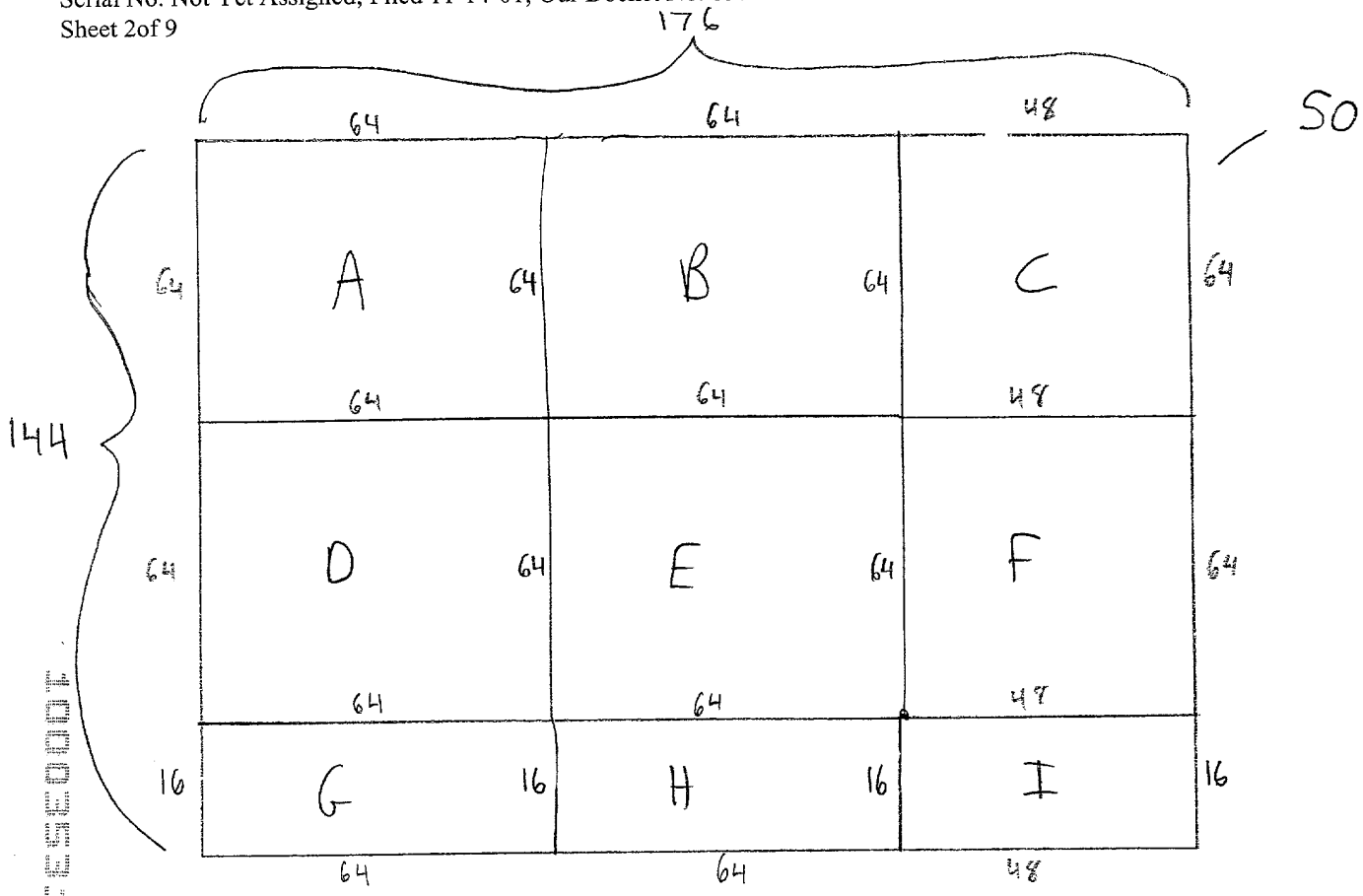

176
64
64
48
50
64
A
64
B
64
C
64
64
64
48
144
64
D
64
E
64
F
64
64
64
48
16
G
16
H
16
I
16
64
64
48

Fig 3

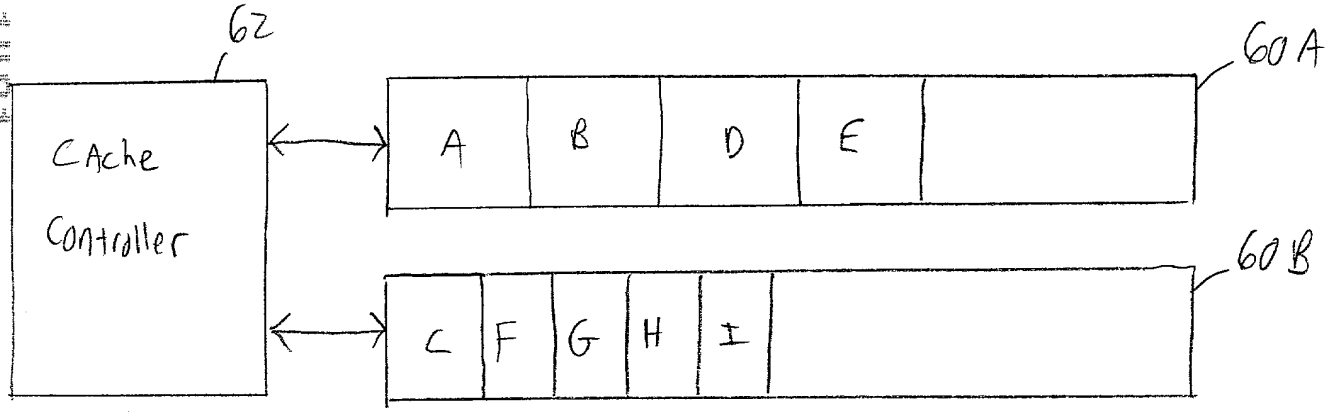
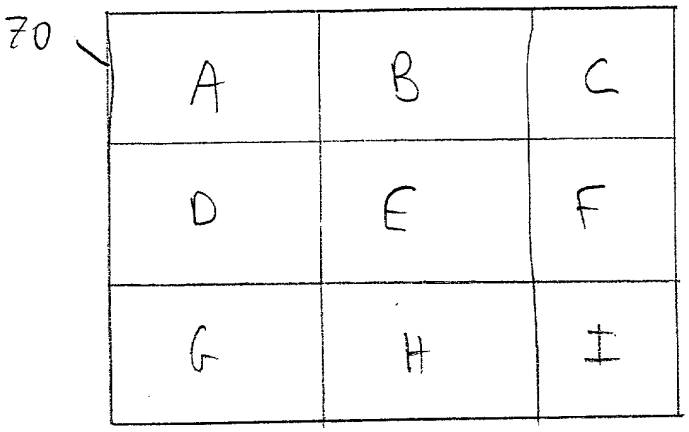

62
60A
Cache
Controller
A
B
D
E
60B
C
F
G
H
I

Fig 4



Terminal Server sends bitmaps:
A, B, C, D, E, F, G, H, I

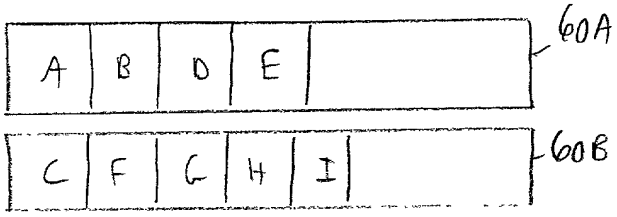
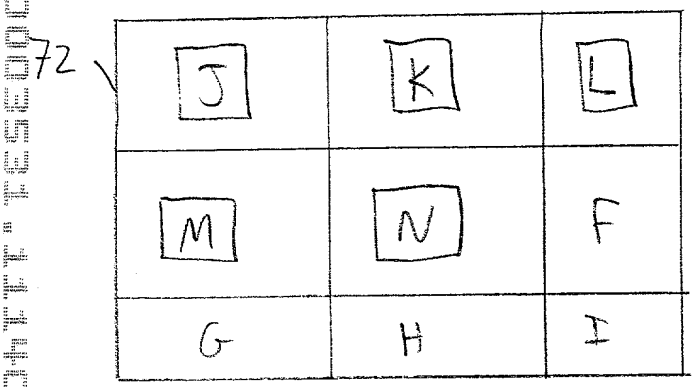


Fig 5A



Terminal Server sends bitmaps
J, K, L, M, N

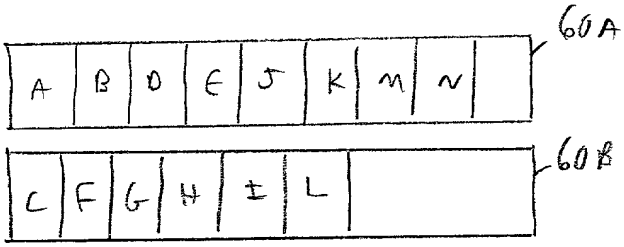
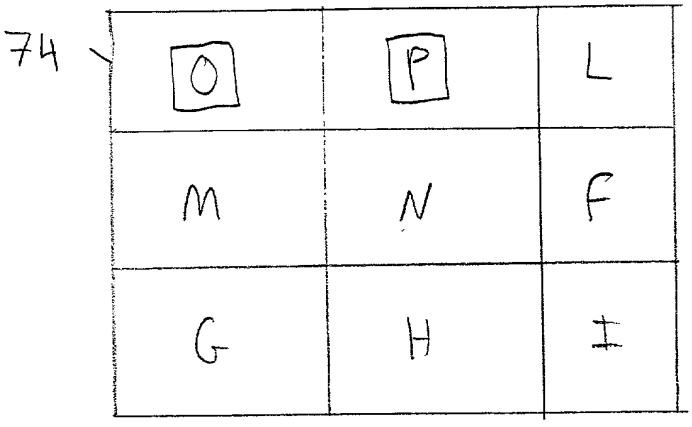


Fig 5B



Terminal Server Sends bitmaps:
O, P

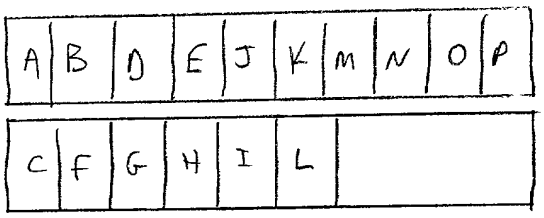


Fig 5C

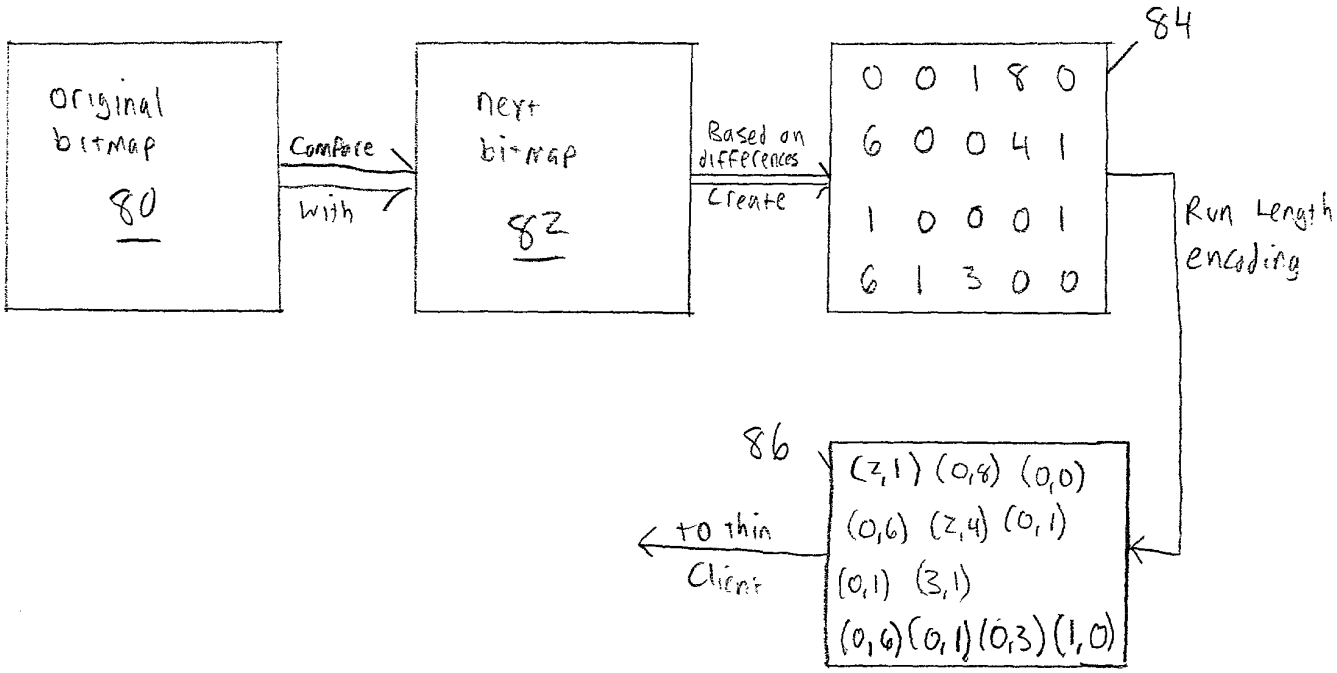

original bitmap
80
Compare
With
next bitmap
82
Based on differences
Create
84
0 0 1 8 0
6 0 0 4 1
1 0 0 0 1
6 1 3 0 0
Run Length encoding
86
(2,1) (0,8) (0,0)
(0,6) (2,4) (0,1)
(0,1) (3,1)
(0,6)(0,1)(0,3)(1,0)
to thin Client

Fig 6A

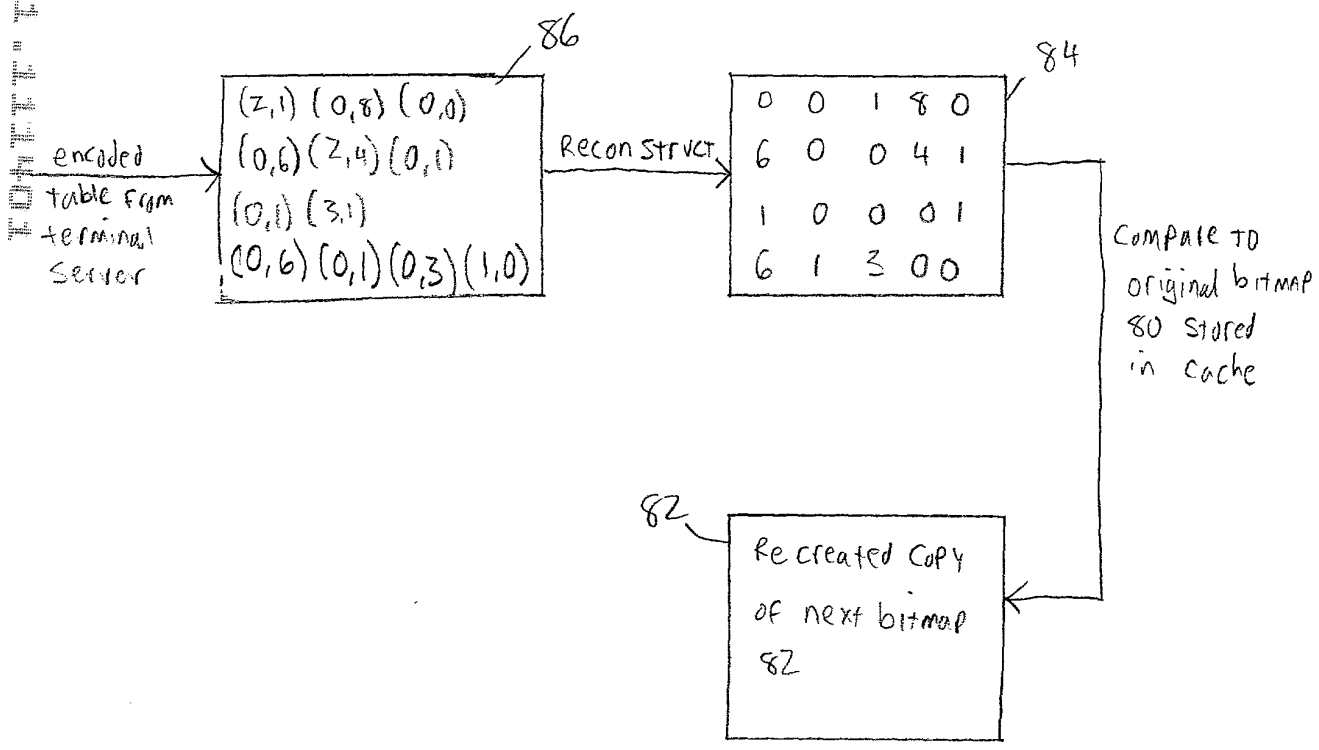

encoded table from terminal Server
86
(2,1) (0,8) (0,0)
(0,6)(2,4)(0,1)
(0,1) (3,1)
(0,6)(0,1)(0,3)(1,0)
Reconstruct
84
0 0 1 8 0
6 0 0 4 1
1 0 0 0 1
6 1 3 0 0
Compare to original bitmap 80 stored in cache
82
Re created Copy of next bitmap 82

Fig 6B

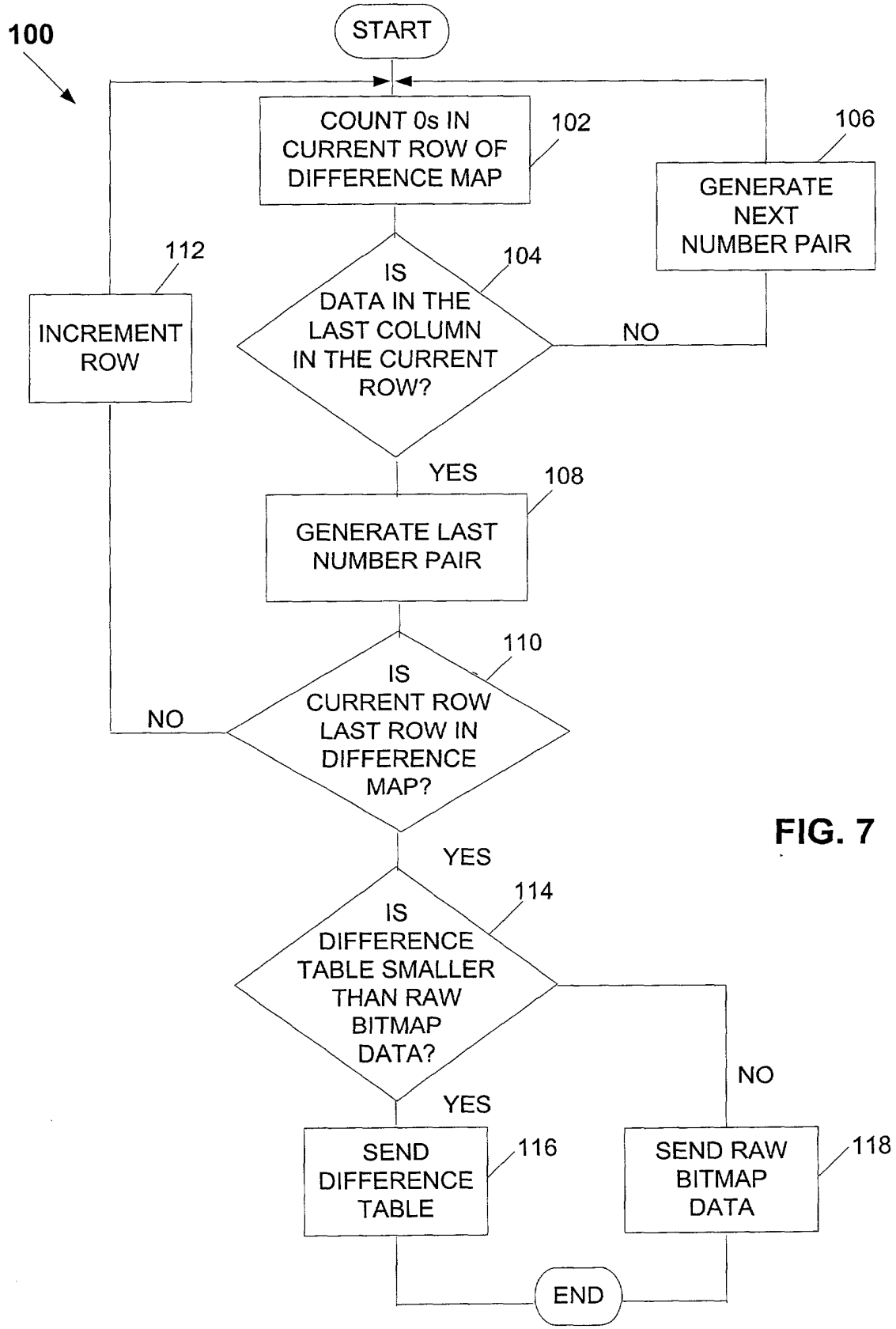

100
START
COUNT 0s IN CURRENT ROW OF DIFFERENCE MAP
102
GENERATE NEXT NUMBER PAIR
106
IS DATA IN THE LAST COLUMN IN THE CURRENT ROW?
104
NO
INCREMENT ROW
112
YES
GENERATE LAST NUMBER PAIR
108
IS CURRENT ROW LAST ROW IN DIFFERENCE MAP?
110
NO
YES
IS DIFFERENCE TABLE SMALLER THAN RAW BITMAP DATA?
114
NO
YES
SEND DIFFERENCE TABLE
116
SEND RAW BITMAP DATA
118
END

FIG. 7

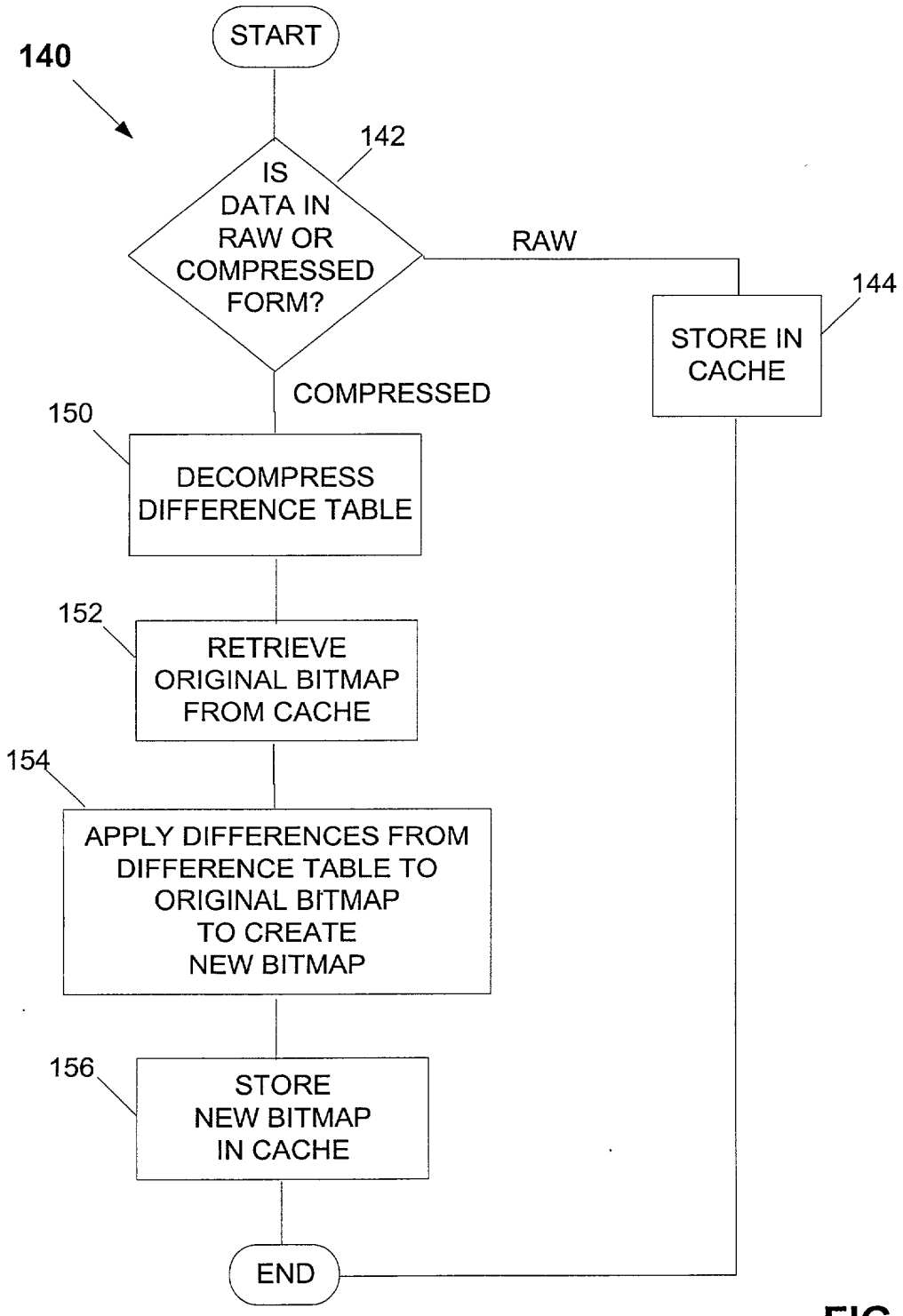

140
START
142
IS DATA IN RAW OR COMPRESSED FORM?
RAW
144
STORE IN CACHE
COMPRESSED
150
DECOMPRESS DIFFERENCE TABLE
152
RETRIEVE ORIGINAL BITMAP FROM CACHE
154
APPLY DIFFERENCES FROM DIFFERENCE TABLE TO ORIGINAL BITMAP TO CREATE NEW BITMAP
156
STORE NEW BITMAP IN CACHE
END

FIG. 8

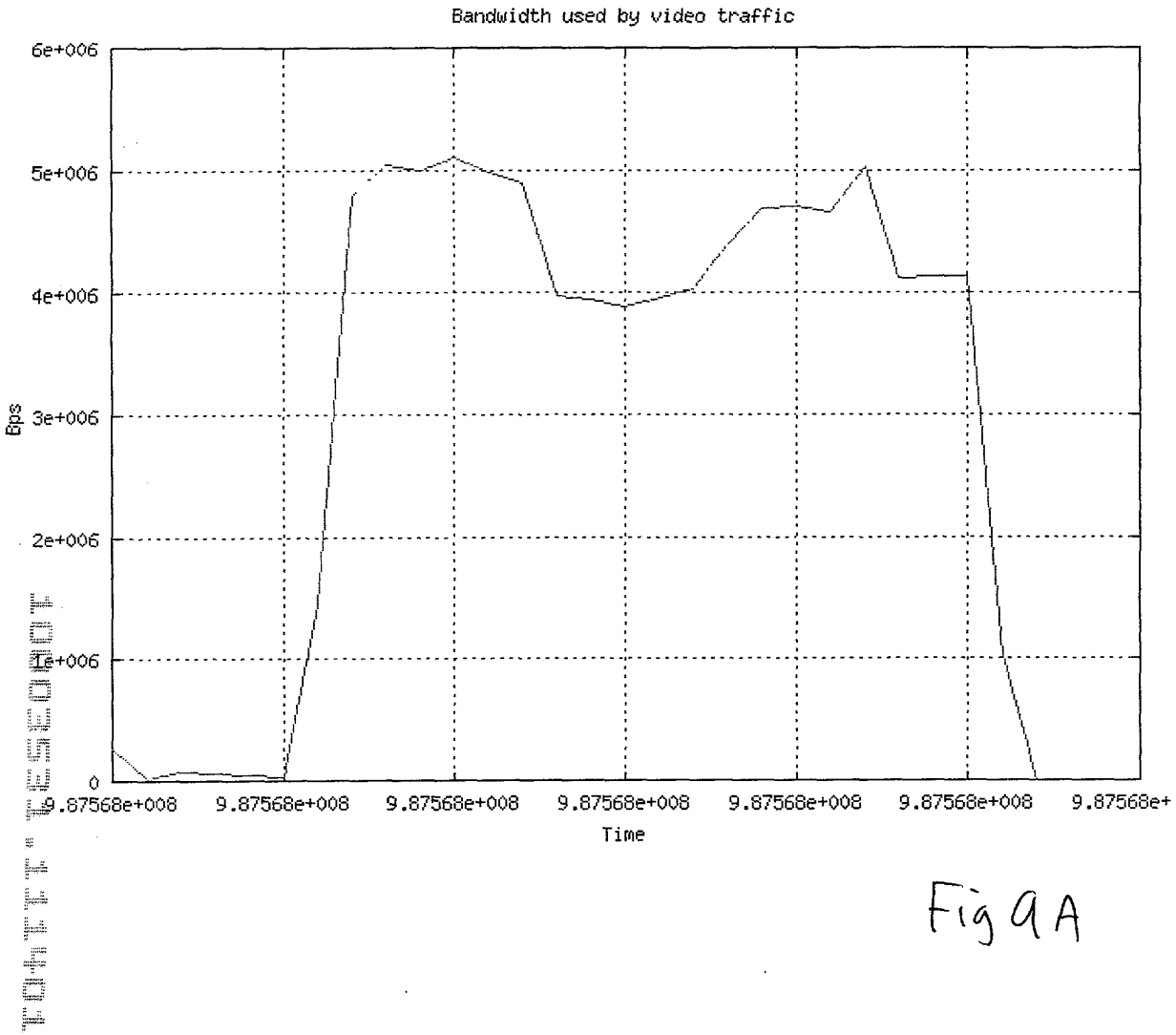

Bandwidth used by video traffic
6e+006
5e+006
4e+006
3e+006
2e+006
1e+006
0
Bps
9.87568e+008
9.87568e+008
9.87568e+008
9.87568e+008
9.87568e+008
9.87568e+008
9.87568e+
Time

Fig 9A

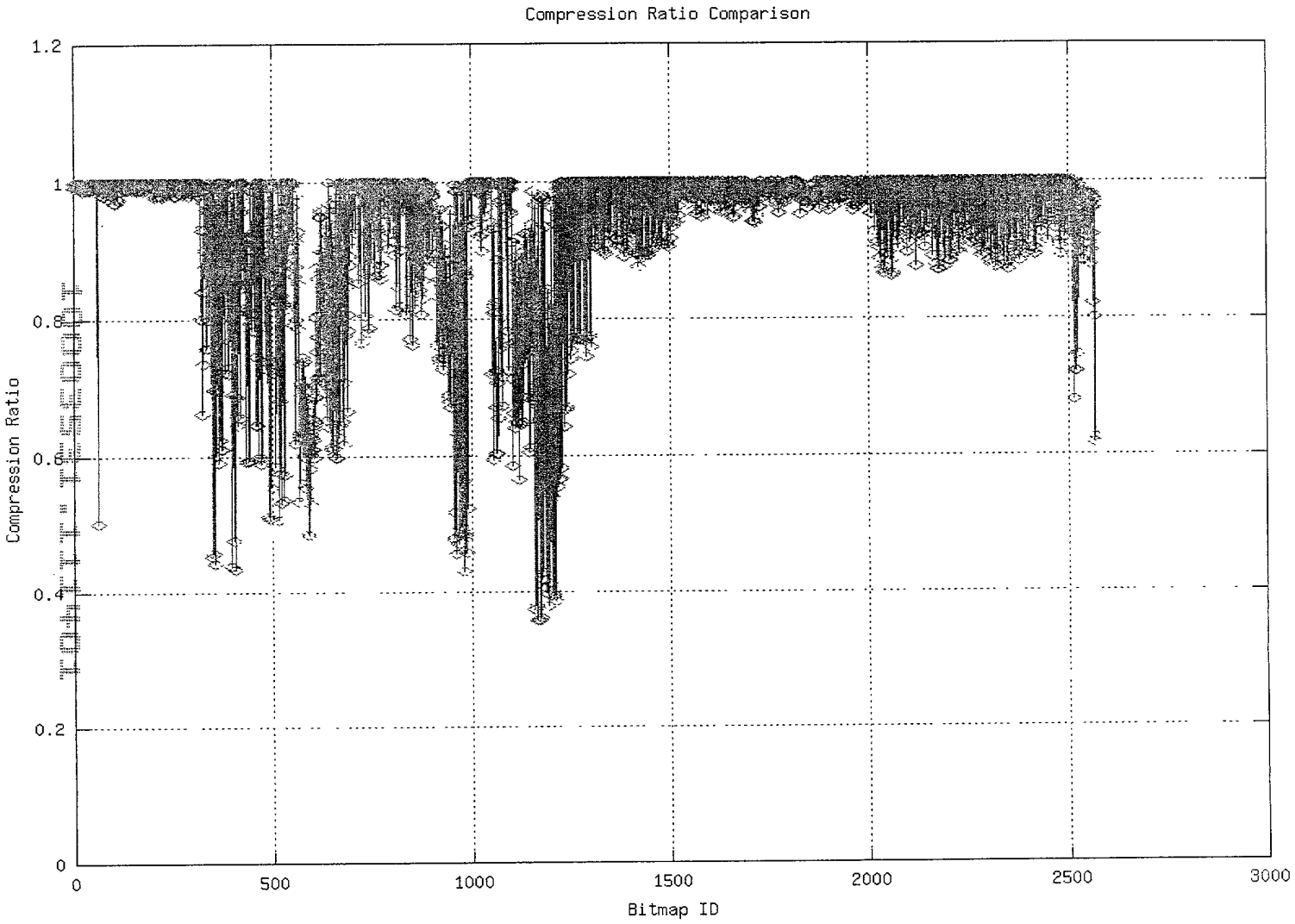

Compression Ratio Comparison
Compression Ratio
1.2
1
0.8
0.6
0.4
0.2
0
0
500
1000
1500
2000
2500
3000
Bitmap ID

Fig. 9B

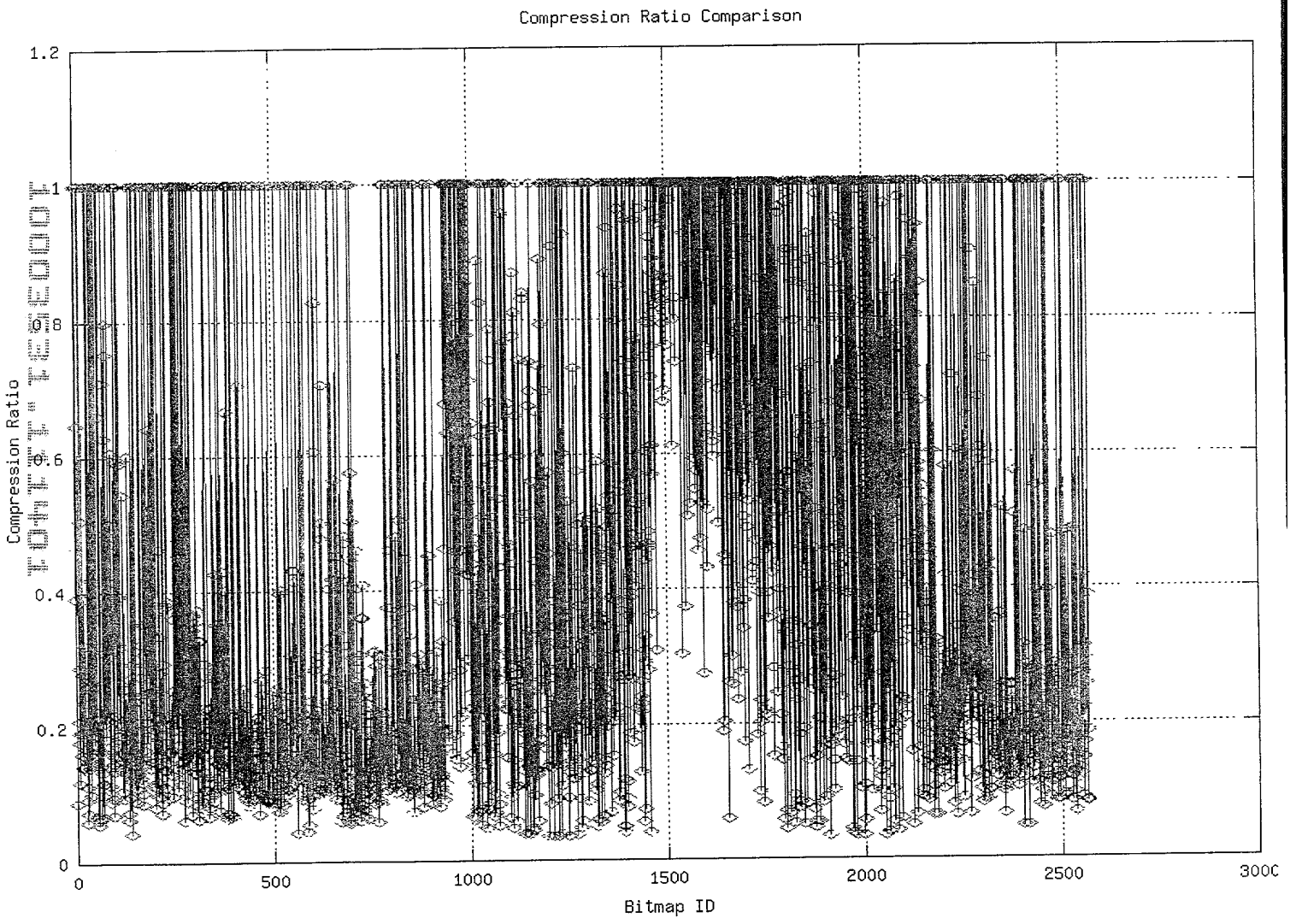

Compression Ratio Comparison
Compression Ratio
Bitmap ID
0
0.2
0.4
0.6
0.8
1
1.2
0
500
1000
1500
2000
2500
3000

Fig. 9C